MULTIMEDIA UNIVERSITY

STUDENT ID NO

MULTIMEDIA UNIVERSITY

FINAL EXAMINATION

TRIMESTER 1, 2016/2017

PEL 0016 – ELECTRICITY AND MAGNETISM

(All sections / Groups)

17 OCTOBER 2016
2.30 p.m – 4.30 p.m
(2 Hours)

INSTRUCTIONS TO STUDENT

1. This question paper consists of 3 printed pages excluding the cover page and the appendixes with FOUR (4) questions.
2. Attempt ALL questions. Distribution of the marks for each question is given.
3. Please write all your answers in the Answer Booklet provided.

Answer **ALL** questions.

Question 1: (15 marks)

a) In **Figure Q1.1** below, four parallel wires are placed one meter each from point P which is located at origin. It is found that the net magnetic field at the point P is directed towards the positive x-axis. All wires carry equal currents.

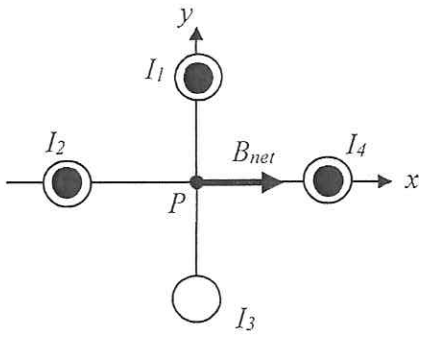


Figure Q1.1

i) What is the direction of current in wire 3 ? Please draw the direction of all magnetic fields in the system at point P. Explain your answer.

[4 marks]

ii) Calculate the magnitude of the current I_3 flowing in wire 3 if the net magnetic field at point P is 18μT .

[5 marks]

iii) A charge Q = 18μ C moves in straight line across point P, in the direction of the magnetic field B_2 (due to current I_2), with a speed of v = 18×10^6 ms^{-1}. Determine the magnitude and direction of the net force, F_{net} exerted on charge Q at point P. Please redraw all directions of vectors (F_{net}, v and B_{net}) across point P.

[3 marks]

b) What is the direction of the current induced in the resistor R_2 (secondary circuit) immediately after the switch S_1, in **Figure Q1.2** is closed? Explain. Is there any changes in your answer if value of resistor R_1 suddenly decrease ?

[3 marks]

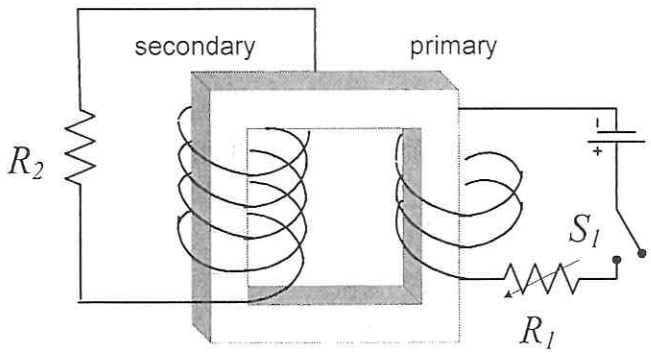


Figure Q1.2

Continued...

Question 2: (15 marks)

The circuit in **Figure Q2.1** is the original circuit and in **Figure Q2.2** is its Thevenin's equivalent circuit.

a) Find R_2 [Hint: Use Thevenin's resistance]. [2 marks]

b) It is found that I_2 is 2.3 mA. Find load current, I_L. [Hint: Use parallel branches of R_2 and R_L]. [2 marks]

c) Determine Thevenin's voltage, V_{Th}. [2 marks]

d) Find V_S. [Hint: Use Thevenin's voltage]. [2 marks]

e) Using **Figure Q2.1**, find Norton's current, I_N. [1 mark]

f) Using Norton's current, I_N found earlier, draw Norton's equivalent circuit. Thus verify that I_L is the same as found in (b). [2 marks]

g) From (a) and (d), use Kirchhoff's law to verify that the value of load current, I_L is the same as found in (b). [4 marks]

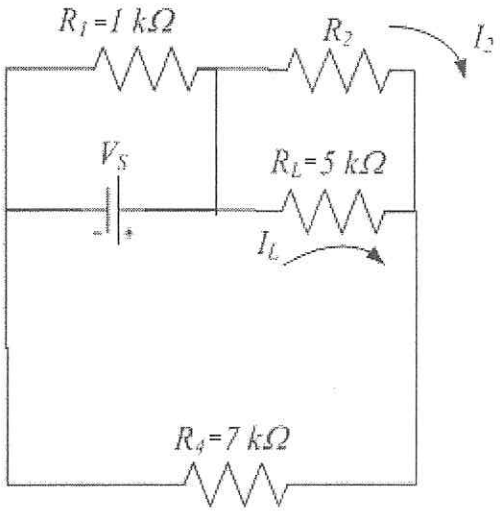


Figure Q2.1

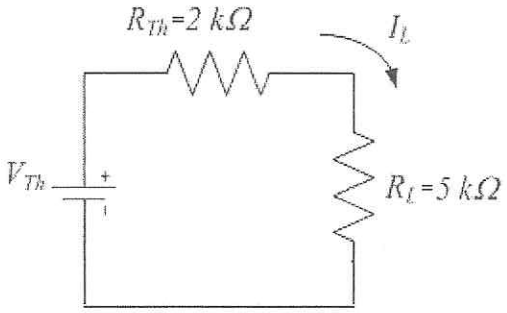


Figure Q2.2

Continued...

Question 3: (10 marks)

An *ac* circuit consisting of a resistor in series with an inductance takes 180.0 W across resistor, at a power factor of 0.6 from a 120.0 V(*rms*), 100.0 Hz supply. Calculate

a) the *rms* current in the circuit. [2 marks]

b) the resistance of the resistor. [1 mark]

c) the impedance of the circuit. [1 mark]

d) the inductance of the inductor. [3 marks]

e) the value of capacitance that must be added to the circuit in series so that the power dissipated is maximum. [3 marks]

Question 4: (10 marks)

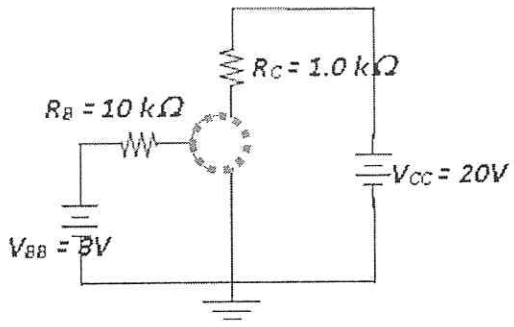
a) i) Sketch the energy band diagrams for metal, insulator and semiconductor respectively. [3 marks]

ii) Which bias condition produces a widening of the depletion region? [1 mark]

b) i) Define ***Rectification***? [1 mark]

ii) Sketch the schematic symbol for diode. [1 mark]

c) Complete **Figure Q4** below by drawing an *npn* transistor in a common-emitter circuit configuration. Show I_B, I_C, and I_E with their respective directions in the same figure. (Redraw **Figure Q4** to show your answer.)



[4 marks]

Figure Q4

End of Paper

APPENDIX I

Physical Constants

Quantity	Symbol	Value
Electron mass	m_e	9.11×10^{-31} kg
Proton mass,	m_p	1.67×10^{-27} kg
Elementary charge	e	1.602×10^{-19} C
Gravitational constant	G	6.67×10^{-11} N.m^2 /kg^2
Gas constant	R	8.314 J/K.mol
Hydrogen ground state	E_o	-13.6 eV
Boltzmann's constant	k_B	1.38×10^{-23} J/K
Compton wavelength	λ_c	2.426×10^{-12} m
Planck's constant	h	6.626×10^{-34} J.s
Speed of light in vacuum	c	3.0×10^8 m/s
Rydberg constant	R_H	1.097×10^7 m^{-1}
Acceleration due to gravity,	g	9.81 m /s^2
Atomic mass unit (1u)	u	1.66×10^{-27} kg
Avogadro's number	N_A	6.023×10^{23} mol^{-1}
Threshold of intensity of hearing	I_o	1.0×10^{-12} W /m^2
Coulomb constant	k	8.988×10^9 N m^2 /C^2
Permittivity of free space	ε_o/κ_o	8.85×10^{-12} C^2/N.m^2
Permeability of free space	μ_o	$4\pi \times 10^{-7}$ H/m

Energy equivalent of atomic mass unit:

One atomic mass unit (1.0 u) is equivalent to 931.5 MeV

APPENDIX II

List of formulas

$$A_v = \frac{V_c}{V_b}$$

$$\alpha_{dc} = \frac{\beta_{dc}}{\beta_{dc}+1}$$

$$\beta_{dc} = \frac{\alpha_{dc}}{1-\alpha_{dc}}$$

$$B = \frac{\mu_0 I}{2\pi r}$$

$$B = \mu_0 nI$$

$$\xi = V + Ir$$

$$\xi = blv$$

$$\xi = -N\frac{\Delta\Phi}{\Delta t}$$

$$\xi = -L\frac{dI}{dt}$$

$$\xi = -M\frac{dI}{dt}$$

$$F = BIL\sin\theta$$

$$F = qvB\sin\theta$$

$$\frac{F}{\ell} = \frac{\mu_0 I_1 I_2}{2\pi d}$$

$$f_r = \frac{1}{2\pi\sqrt{LC}}$$

$$I_{tot} = \sqrt{I_R^2 + (I_L - I_C)^2}$$

$$I = neA(v_n + v_p)$$

$$I = nev_d A$$

$$I = I_{max}\sin\omega t$$

$$I_{rms} = \frac{I_{max}}{\sqrt{2}}$$

$$I_x = \left(\frac{R_T}{R_x}\right)I_T$$

$$L = \frac{N\Phi_B}{I}$$

$$L = \frac{\mu_o N^2 A}{l}$$

$$M = \frac{N\Phi_B}{I}$$

$$M = \frac{\mu_o N_1 N_2 A}{l}$$

$$P = IV = I^2R = \frac{V^2}{R}$$

$$P_t = I_{rms}V_{rms}\cos\phi$$

$$P_r = V_{rms}I_{rms}\sin\phi$$

$$P_a = I_{rms}^2 Z$$

$$R = \frac{\rho L}{A}$$

$$R = R_0\left[1+\alpha(T-T_0)\right]$$

$$R_T = R_1 + R_2 + R_3 + \ldots$$

$$\frac{1}{R_T} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + \ldots$$

$$r = \frac{mv}{Bq}$$

$$\tau = NBIA\sin\theta$$

$$U = \frac{1}{2}LI^2$$

$$U = \frac{1}{2}B^2 A\frac{l}{\mu_o}$$

$$V_H = Bvd$$

$$V = V_{max}\sin\omega t$$

$$V_{rms} = \frac{V_{max}}{\sqrt{2}}$$

$$V_x = \left(\frac{R_x}{R_T}\right)V_S$$

$$X_C = \frac{1}{2\pi fC}$$

$$X_L = 2\pi f L$$

$$Z = \sqrt{R^2 + (X_L - X_C)^2}$$

$$\oint B.dl = \mu_o I$$

$$d\mathbf{B} = \frac{\mu_O I}{4\pi}\frac{d\ell\times\hat{\mathbf{r}}}{r^2}$$

$$\Phi_B = BA\cos\theta$$

$$\cos\phi = \frac{R}{Z}$$

$$\tan\phi = \frac{X_L - X_C}{R}$$